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SELECTIVITY BIAS IN ESTIMATING THE EFFECT OF CREDIT ON OUTPUT: THE CASE OF RURAL NONFARM ENTERPRISES IN THE PHILIPPINES

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Abstract

This study uses an endogenous switching regression model to measure the effect of credit on output under assumptions of selectivity bias. The model allows for the separation of the true credit effect from the effect of observable and unobservable characteristics of borrowers and nonborrowers. Thus, it becomes possible to clearly identify the different components that undelie the observed performance gap between borrowers and nonborrowers. Using data from a survey of rural nonfarm enterprises in the Visayas Region in the Philippines, the econometric estimates provide strong empirical support for the positive relationship between credit and output.

Selectivity Bias in Estimating the Effect of Credit on Output: The Case of Rural Nonfarm Enterprises in the Philippines

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1. Introduction

Rural nonfarm enterprises have sparked interest among development practitioners because of their potential to generate income and employment in rural areas [Ho (1980), Binswanger (1983), Haggblade et al. (1986), Liedholm and Mead (1987), Vijverberg (1988), Liedholm (1990), Ranis and Stewart (1990), Duggleby et al. (1992), and Ahmed and Randolph]. Programs to facilitate the development of these enterprises have subsequently emerged, often designed within the supply leading financial policy framework [see Liedholm and Mead (1987), Boomgard (1989), Levitsky (1989), Otero (1989), and Webster (1989), among others]. In this approach, the main objective is to assist entrepreneurs to obtain financial services more easily and quickly than would occur if financial markets were left to respond to market demand. This approach is anchored in the notion that credit is panacea to the difficulties experienced by these enterprises. Empirical studies have shown that financial constraints in the form of working capital shortages and/or cash shortages are often the major problems perceived by entrepreneurs as hindering the growth of their enterprises [see Liedholm (1989) for a review of these studies]. Thus, by relaxing the financial constraints through the provision of additional funds from credit, it is believed that productivity gains will be realized.

The potential gain in productivity resulting from additional funds, however, may or may not be realized depending on the degree to which financial constraints affect the economic behavior of the enterprise. Providing credit to an enterprise facing binding financial constraints may result in positive marginal effects on output, but may have no marginal effect on the output of an enterprise facing nonbinding financial constraints. In addition, the marginal effect of credit may differ among those enterprises that actually use it. Although credit can increase output, there are certain inherent borrower characteristics that determine the degree to which credit is or is not used and its resulting marginal effects on output [Adams (1988)]. Thus, any productivity differential observed among borrowers and nonborrowers may reflect pre-existing differences in productivity as well as the effect of relaxed financial constraints.

Determining the actual effect on output of additional funds obtained from loans is a tricky matter because of the identification problem or the difficulty of clearly attributing the effect from a specific factor because of the "noise" caused by the other effects. This identification problem subsequently results in imprecise measurement and estimation of credit effects, thereby contributing to a poor understanding of the impact of improved access to credit [Carter (1989)]. David and

Meyer (1980) pointed out that fungibility contributes to the difficulty in obtaining a precise measure of the "additionality" effect of credit. Empirical problems arising from the likely heterogeneity of borrowers and nonborrowers can also affect the estimation of the true credit effects. While descriptive statistics often show differences in the average performance of borrowers and nonborrowers, it does not measure the proportion of the difference attributable to borrowing alone. This is because the difference measured is distorted by the effects arising from the likely heterogeneity of the sample; i.e., borrowers have different inherent characteristics compared with nonborrowers, as a result of an endogenous sorting process where credit status is an outcome of the individual's decision to apply for a loan and the lender's decision to provide it. As Adams (1988) pointed out, it is likely that borrowers would be more productive than nonborrowers even without credit because of better inherent characteristics. It is important, therefore, to isolate the effect of credit on productivity from the effect of inherent characteristics of the enterprise and of the entrepreneur. By doing so, a more accurate and realistic assessment can be made of the effectiveness of using credit as a means to promote the development of rural nonfarm enterprises.

This paper addresses the issue of estimating the true effects of credit on the productivity of rural nonfarm enterprises. An econometric model that takes into account the non-random sorting of the sample between borrowers and nonborrowers is used to segregate the impact of credit from the impact of latent and observable characteristics of borrowers and nonborrowers. This approach is an improvement over the conventional use of OLS in estimating output supply equations and deriving credit effects from the estimated coefficients. By correcting for the selection bias, this econometric approach yields consistent and unbiased estimates of the parameters [Maddala and Nelson (1975)].

2. A descriptive profile of borrowers and nonborrowers

Table 1 presents descriptive statistics of borrowers and nonborrowers among the rural nonfarm enterprises surveyed in the Visayas region of the Philippines as part of the Dynamics of Rural Development Project of the Philippine Institute for Development Studies (PIDS) funded by the United States Agency for International Development (USAID). A discussion of the sampling design is presented in the Appendix. The results indicate positive and statistically significant differentials in favor of borrowers in terms of gross sales, net income, total assets, and number of workers.[1]

The descriptive statistics similar to those often presented in surveys of enterprises in developing countries, in that they imply that borrowers are more productive than nonborrowers. For example, borrowers on the average have larger gross sales and net income than nonborrowers. Borrowers also appear to be larger in terms of number of workers and they reinvest more income than nonborrowers do. There is a serious weakness in accepting the results

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[1] A detailed discussion of the descriptive profile of borrowers and nonborrowers among the sample enterprises is presented in Lapar (1994).

of these descriptive statistics at face value, however, because they attribute differences in productivity and resource use between borrowers and nonborrowers solely to the use of credit. While it may be true that credit is associated with productivity gains, it is not clear whether it actually causes them or merely reflects pre-existing differences between borrowers and nonborrowers. For example, better skills and managerial abilities of the entrepreneur should be reflected in a positive effect on output. But since these qualities are not directly observable, their effects may be confounded by the effects of other observable factors like borrowing. It is the presence of latent factors that are likely to be correlated with credit that makes the unconditional descriptive statistical analysis a biased measure of the variation in productivity between borrowers and nonborrowers.

3. A selectivity model

A selectivity model is used in order to disentangle the effects of credit from the effects of observable and latent attributes of borrowers vis-a-vis nonborrowers. The model developed follows those of Carter (1989), Feder et al. (1990), and Sial and Carter (1992). Let Q(.) be the anticipated output supply, defined as a function of loan size "L" and other characteristics. Output for an enterprise "i" is produced according to one of two production regimes:

$$(1) \qquad Q_i = \begin{cases} Q_{ic} = \alpha'\ell_i + \beta_c'z_i + (v_{ic} + \epsilon_{ic}) \text{ if a borrower;} \\ Q_{in} = \beta_n'z_i + (v_{in} + \epsilon_{in}) \text{ otherwise.} \end{cases}$$

In this switching regressions specification, the base regime, denoted with a subscript "n", is the case that represents nonborrowers. The other regime, denoted with a subscript "c", represents borrowers. The right hand side variables are partitioned into the observable and unobservable variables, ℓ_i and z_i, respectively. The vector ℓ_i is a quadratic expansion of the loan amount L_i. The impact of loans on output supply is given by $\alpha'\ell_i$, a nonlinear function of L_i which allows for diminishing returns to loans. On the other hand, the vector z_i includes variables that account for market opportunities, fixed factors of capital and labor, and entrepreneurial characteristics, among others. The parameters β_j (j=n,c) give the impact of the observable variables on output supply and are allowed to vary between the two regimes in (1) to allow for the possibility that relaxing financial constraints may permit an entrepreneur to earn larger returns from a given market opportunity and level of fixed factors.

The latent variables are divided into those that are known (the v_i's) and those that are unknown (the ϵ_i's). The v_i's give the effect of inherent enterprise and entrepreneur characteristics such as managerial and entrepreneurial skills on output supply. While these are known to the individual, they are not observed by the econometrician. It can be assumed that this latent variable is scaled such that $E(v_i)=0$ for an individual selected at random from the overall rural nonfarm enterprise population of borrowers and nonborrowers. The v_i's are allowed to differ across the two production regimes in the full switching regression specification to accommodate the productivity effect of differences in the attributes between borrowers and nonborrowers (e.g., a relaxed financial constraint may result in larger returns to latent managerial ability). The ϵ_i's

are the conventional, unanticipated random supply shocks unknown to the entrepreneur at the time production decisions are made and it is assumed that $E(\epsilon_i)=0$.

Estimation of the parameters in the output supply equation (1) is complicated by the fact that credit status is endogenously determined in a way that may be systematically related to the expected credit effects (Carter 1989). Under this endogenous sorting, it is likely that borrowers have systematically different attributes from nonborrowers. Thus, while $E(v_i)=0$ for an individual randomly chosen from the overall population, it seems likely that the latent variable v_i has a nonzero conditional expectation for the two non-randomly sorted subsamples of borrowers and nonborrowers. There is a need, therefore, to specify the non-random process that sorts individuals into borrowers and nonborrowers in order to obtain consistent estimates of the production regime parameters and to identify the effect of credit on output.

The process that sorts borrowers and nonborrowers into the two regimes involves the decision of the individual to apply for a loan and the decision of the lender to make a loan. This implies two selection criterion functions, where, say, I_1^* refers to the individual's decision whether or not to apply for a loan, and I_2^* refers to the lender's decision whether or not to grant the loan.[2] The analysis of models with more than one selection criterion function depends critically on whether the two decisions are independent or correlated; that is, whether or not the covariances of the error terms in the two criterion functions are zero. If the covariance is zero, implying independence, then the estimation of the parameters of the model is feasible and tractable. However, if the covariance is not zero, implying non-independence, which in the case of borrower and lender decisions is a realistic assumption, then estimation becomes more difficult because the expressions of the expected values of the error terms "get very messy" (Maddala 1983, p.282). In this case, the bivariate probit method is used to estimate the criterion functions (Fishe et al. 1981). This approach is deemed not feasible in this study, however, because of the lack of

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[2] Note that the individual's decision whether or not to apply for a loan and the lender's decision whether or not to grant a loan can be modelled as either as a sequential or a joint-decision process. In both cases, there should ideally be two criterion functions to represent the individual's and the lender's separate decision choice, where the individual's criterion function can represent the demand for credit and the lender's criterion function, the supply of credit. However, if marginal and conditional inferences are needed to be made in the analysis, then the sequential-decision selection approach to model the criterion function may not be the appropriate approach (see Maddala 1983). The resulting truncation in the sample has been shown to affect the quality of the estimates of the parameters of the selectivity criterion even if it is still possible to correct for the selectivity bias in the OLS estimates of the parameters of the second stage equation (Maddala 1983, p.267). An alternative way of modelling the criterion function is to consider the individual's decision whether to apply for a loan and the lender's decision whether or not to grant a loan as a joint decision. This approach can be justified by the fact that what we actually observe is whether an individual is a borrower or a nonborrower and we do not observe the individual decisions of the individual borrower and the lender.

information about the decision-making process of the lenders, i.e., there is no information in the data set pertaining to the factors used by lenders in deciding whether or not to grant a loan. Thus, a second best approach is used wherein a single probit equation which is an approximation of the two-probit equations.[3] Let this single probit equation be termed the credit status equation which includes factors affecting the individual's decision to apply for a loan and the lender's decision to grant a loan. In the absence of information from the lender's side, factors from the borrowers' side are used to infer lender behavior.

Credit status can be represented by the binary variable D_i which equals one if a borrower and zero otherwise. D_i can be modelled as a result of a latent credit access variable, $\mathcal{L}_i$ which is scaled such that an individual becomes a borrower when $\mathcal{L}_i > 0$. A reduced form specification for latent credit access can be written as:

$$(2) \qquad \mathcal{L}_i = \gamma' x_i + \eta_i ,$$

where x_i is a vector of variables that determine credit access, γ is a vector of parameters, and η_i is an error component reflecting random and latent factors that influence credit access. Thus, the sample separation process can be written as:

$$(3) \qquad D_i = \begin{cases} 1 \text{ if } \mathcal{L}_i = \gamma' x_i + \eta_i > 0, \text{ or } \eta_i > -\gamma' x_i \\ 0 \text{ otherwise.} \end{cases}$$

The expected output supply conditional on the endogenous sample separation process and observable characteristics can then be written as:

$$(4a) \qquad E(Q_{ic} | D_i=1) = \beta_c' z_i + \alpha' \ell_i + E(v_{ic} | D_i=1)$$

$$(4b) \qquad E(Q_{in} | D_i=0) = \beta_n' z_i + E(v_{in} | D_i=0)$$

where conditioning on the observable variables z has been suppressed. The conditional expectations on the right hand side can be rewritten as:

$$(5a) \qquad E(v_{ic} | D_i=1) = E(v_{ic} | \eta_i > -\gamma' x_i)$$

$$(5b) \qquad E(v_{in} | D_i=0) = E(v_{in} | \eta_i < -\gamma' x_i)$$

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[3] It is recognized that the second best approach usually will not result in estimated parameters that are comparable with those obtained using the ideal model. In this case, the use of the single probit equation to approximate the two-probit criterion functions may result in biased estimates of the parameters of the criterion function.

Note that from (5) the problem of intrinsic productivity differences between borrowers and nonborrowers can be clearly seen. If latent productivity attributes are systematically related to credit status, then the conditional expectations in (5) will not be zero. For example, individuals with better entrepreneurial skills are likely to realize larger output supply (via v_{ic}) as well as have higher probability of obtaining credit under non-random sorting (via η_i), implying that $E(v_{ic}|D_i=1) > 0$ in the borrower subsample. Under these circumstances, estimating the output supply equation using OLS[4] will not yield consistent estimates of the structural parameters because of the correlation between latent managerial skill and the observed loan amount. In this case, the direct output effect of latent managerial skill is attributed to the observed loan amount with which it is correlated.

The problem of non-random sorting that underlies the inconsistency of OLS fortunately suggests a resolution of the estimation problem. The problematic correlation between the v_i and η_i indicates that the latter in fact provides information on the latent variable v. Thus, the parameters of interest can be consistently estimated by using this information to control for the latent characteristics v_{ic} and v_{in}. By assuming that the error vector (η_i, v_{ic}, v_{in}) is distributed multivariate normal with zero expectations and positive definite covariance matrix [Maddala (1983)], a full endogenous switching regressions system can be written as:

$$(6a) \quad D_i = \begin{cases} 1 \text{ if } \eta_i > -\gamma' x_i \\ 0 \text{ otherwise.} \end{cases}$$

$$(6b) \quad E(Q_{ic}|D_i=1) = \beta_c' z_i + \alpha' \ell_i + \rho_c \lambda_i^c$$

$$(6c) \quad E(Q_{in}|D_i=0) = \beta_n' z_i + \rho_n \lambda_i^n$$

where $\rho_c = Cov(\eta_i, v_{ic})/Var(\eta_i)$ and $\rho_n = Cov(\eta_i, v_{in})/Var(\eta_i)$ are the population regression coefficients relating the v_{ic} and v_{in}, respectively; $\lambda_i^c = \phi(C_i)/\Phi(C_i)$ and $\lambda_i^n = \phi(C_i)/1-\Phi(C_i)$ are the estimates of η_i given borrower type and $C_i = \gamma' x_i/Var(\eta_i)$; $\phi(.)$ and $\Phi(.)$ are the standard normal density and cumulative distribution functions, respectively.

The parameters of this system can be estimated using maximum likelihood methods. Heckman proposes a two-stage procedure for estimating consistent but less efficient parameters of (6) [Maddala (1983)]. The procedure is as follows. Obtain estimates of $\gamma_i/Var(\eta_i)$. Using

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[4] However, even if OLS cannot separately identify the effect of credit from the effect of latent attributes, it does give the best linear estimate of the (gross) output supply gap between non-randomly sorted borrowers and non-borrowers (Sial and Carter 1992). This gross output supply gap can be written as:

$E(Q_{ic}|v_{ic}) - E(Q_{in}|v_{in}) = \delta' z_i + \alpha' \ell_i + [E(v_{ic}|D_i=1) - E(v_{in}|D_i=0)]$, where $\delta = (\beta_c - \beta_n)$.

these, get the estimated values of $\phi(C_i)$ and $\Phi(C_i)$ and use these to construct λ_i^c and λ_i^n. Consistent estimates of β may be obtained through separate OLS regressions of the two conditional output supply functions in (6). Alternatively, it is possible and often desirable to estimate (6) using all the observations in Q_i [Maddala (1983)]. Note that

(7) $E(Q_i) = E(Q_{ic}|D_i=1)Prob(D_i=1) + E(Q_{in}|D_i=0)Prob(D_i=0)$, so that

(8) $E(Q_i) = \beta_c'z_i + \delta'[\Phi(C_i)z_i] + \alpha'[\Phi(C_i)\ell_i] + (\rho_c - \rho_n)\phi(C_i)$.

This specification in (8) allows for the estimation of direct credit effect parameters, the α, and the indirect credit effect parameters, the δ and the $(\rho_c - \rho_n)$ [Sial and Carter (1992)]. While the direct effect parameters give the increase in output supply due to the use of loans, the indirect credit effects represent the additional returns to observable and unobservable endowments when credit is used. If the loans do not enhance the returns to other factors, i.e., both δ and $(\rho_c - \rho_n)$ are equal to zero, then (8) reduces to the following equation:

(9) $E(Q_i) = \beta_c'z_i + \alpha'[\Phi(C_i)\ell_i]$.

Equation (9) is a restricted form of (8) wherein credit has direct effects only; however, these effects still cannot be estimated using OLS given the non-random sorting of individuals between borrowers and nonborrowers.

4. Credit effect measures

The credit effect measures to be used in determining the impact of credit on output are defined as follows [Carter (1989), Sial and Carter (1992)]:

(10a) Random credit effect:

$$E(Q_{ic}-Q_{in}) = [\beta_c'z_i + \alpha'\ell_i + E(v_i|D_i=1)] - [\beta_n'z_i + E(v_i|D_i=0)]$$
$$= \delta'z_i + \alpha'\ell_i$$

(10b) Counterfactual credit effect for borrowers

$$E(Q_{ic}|D_i=1) - E(Q_{in}|D_i=1) = [\beta_c'z_i + \alpha'\ell_i + E(v_{ic}|D_i=1)] - [\beta_n'z_i + E(v_{in}|D_i=1)]$$
$$= \delta'z_i + \alpha'\ell_i + (\rho_c - \rho_n)\lambda_i^c.$$

(10c) Counterfactual credit effect for nonborrowers:

$$E(Q_{ic}|D_i=0) - E(Q_{in}|D_i=0) = [\beta_c'z_i + \alpha'\ell_i + E(v_{ic}|D_i=0)] - [\beta_n'z_i + E(v_{in}|D_i=0)]$$
$$= \delta'z_i + \alpha'\ell_i + (\rho_c - \rho_n)\lambda_i^n.$$

The random credit effect measure determines the effect of credit were it given to an individual selected at random from the overall population of rural nonfarm entrepreneurs. The expected value of latent attributes for such an individual is zero. On the other hand, the measure of

counterfactual credit effect compares the output anticipated by an individual under the actual credit status with the output level that would be anticipated by that same individual in the counterfactual state [Tunali (1985), Carter (1989), Sial and Carter (1992)]. Note that both counterfactual measures are in fact the sum of the random credit effect and the gains or losses the individual would anticipate given the latent characteristics. While the random credit effect can show the effect of credit on the output supply of an individual with the same observable attributes as the other individuals in the sample, the counterfactual credit effect can indicate the impact of credit on the output of individuals who choose to be or not to be borrowers. Both the random and counterfactual effects are measures of total effect of credit on output supply. In order to determine the marginal effect of additional credit on output supply, we use the marginal credit effect which is defined as the partial derivative of output with respect to loan amount. This measure is shown as:

$$(11) \quad \partial E(Q_i \mid D_i)/\partial L_i = \alpha'[\Phi(C_i)].$$

5. Empirical estimation of the model

The empirical estimation of the econometric model requires the specification of the criterion function which sorts the sample into the two regimes, namely, borrowers and nonborrowers, as well as the output supply equation. These two equations constitute the endogenous switching regression model. Following Heckman's two-stage procedure discussed above, the first stage equation or the criterion function is estimated using the univariate probit procedure and the second stage equation is estimated using the ordinary least squares procedure. The first stage equation, labelled as the credit status equation, is a function of the entrepreneur's decision to apply for a loan and the lender's decision to grant a loan. Hence, this equation ideally is specified as a function of variables that indicate demand for and supply of credit to reflect the individual's decision whether or not to apply for a loan and the lender's decision whether or not to grant a loan. As the criterion function in the model, this equation sorts the sample into the two regimes of borrower and nonborrower. In this sense, this function includes the variables that determine or affect credit access.

For the empirical estimation of this equation, the independent variables included those factors that explain the borrower's demand for and supply of credit (see Table 2). These variables include the value of fixed assets, total assets, and financial assets owned by the entrepreneur, previous year's income, number of years the enterprise has been operating, age of the owner/operator, number of years spent in school (as a measure of educational attainment), and a dummy variable for bank-client relationship, i.e., existence of a bank account, which equals one if the operator has a bank account and zero otherwise. Dummies for gender, type of activity undertaken and for the province where the enterprise operates are also included. These variables were chosen from the literature on credit access [see Feder et al. (1990), Kochar (1992), and Sial and Carter (1992), for example].

The second stage equation is the output supply equation. This equation is specified as a function of fixed and non-fixed inputs and other observable characteristics. The variables included in the output supply equation are the number of family and hired workers, value of total assets, cost per hour of labor, number of years the enterprise has been operating (or firm age), average number of hours the enterprise operates, working capital, the amount of loan received, and amount of loan received squared. These variables were chosen from the empirical literature such as the works of Carter (1989), Feder et al. (1992), and Sial and Carter (1992). A quadratic form of the loan amount variable is included to account for the direct effect of credit on output. The loan variable measures the total value of loans received by borrowers during the period 1989-1991, i.e., the preceding two years and the current year of operation covered in the study. Dummy variables for province and type of activity are also included in the output supply equation to account for market and sector effects on output. For the actual estimation of the output supply equation, the dummy variables for Negros Occidental and services were dropped. The dependent variable is the value of output.

The data set used in estimating the model was obtained from a survey of rural nonfarm enterprises in the Visayas region of the Philippines. The survey area included the provinces of Iloilo, Negros Occidental, Cebu, and Bohol where a higher degree of economic activity were observed relative to the other parts of the Visayas region. With Visayas considered one of the growth centers in the Philippine government's latest Medium-Term Development Plan, it can be a potential hub of economic activity in the coming years implying better economic opportunities for rural nonfarm enterprises in the region. There were 400 sample enterprises in the data set, of which 125 were engaged in manufacturing, 164 in trading, and 111 in services (see Appendix for the description of the sampling design).

5.1. Results of the probit equation estimation

Results of the estimated probit equation for credit status show that of the independent variables included, only total assets, financial assets, no. of years in school, and the dummy variables for gender, Iloilo (provincial dummy), and trading (activity dummy) are statistically significant (see Table 3). The subsequent discussion focuses on these variables.

The positive coefficient for financial assets indicates that the more financial assets (in the form of savings and checking account with a financial institution) the entrepreneur has, the more likely he or she will be to obtain a loan because such financial assets act as a proxy for the collateral substitute of an established bank-client relationship. This result is consistent with credit rationing theory. The positive effect of this bank-client relationship on securing credit was also validated in a separate study on credit rationing in the Philippines (Lapar 1988). It was shown that borrowers who have a longer relationship with a bank, either through maintaining an account in a bank or having good credit records, are less likely to be credit rationed.

The total assets variable has a negative coefficient, implying a result that is consistent with the "pecking order theory." The more assets the entrepreneur has that he can easily liquidate, the

more likely that such an entrepreneur will not seek external funds but utilize internal resources to operate the enterprise. This reasoning follows the "pecking order theory" [Cuevas (1992), Myers (1985)] wherein a firm chooses from a hierarchy of preferences in deciding on the source of financing to utilize. This choice is based on the "safety first principle" with internal funds being the safest (i.e., defined as not potentially losing control over the firm) among the choices. The result obtained empirically validates this proposition.

The positive coefficient of number of years in school, a proxy variable for education, implies that more educated entrepreneurs are perceived to be more productive, and hence, are more creditworthy and able to borrow than those with less education. This result is consistent with the results obtained from other empirical studies [e.g., Sial and Carter (1992) in India, Baydas et al. (1992) in Ecuador, and Feder et al. (1990) in China]. It was found that lenders to microenterprises in Ecuador are more likely to grant loans to better educated entrepreneurs. Similarly, better educated farmers in China are less likely to be credit constrained through institutional sources [Feder et al. (1990)].

The dummy variable results show that enterprises in Iloilo are more likely to obtain loans, while female entrepreneurs and enterprises engaged in trading are less likely to be borrowers. The joint hypothesis that all the coefficients of the probit equation are zero is rejected at the one percent level.[5]

5.2. Results of the output supply equation estimation

Two variants of the output supply equation are estimated: the full switching model (equation 8), and the restricted model (equation 9). The difference between the full and the restricted model is that the latter assumes there are no added returns to observable and unobservable characteristics of the enterprise and the entrepreneur from the use of credit, i.e., the δ and (ρ_c - ρ_n) parameters are equal to zero.

The full switching regression estimates show that borrowers do not obtain differential returns from observable characteristics as shown by their estimated δ values, none of which are statistically significant at the 5 percent level (see Table 4). It was also impossible to reject the hypothesis that aside from the direct effect of the loan, borrowers experience no additional returns to their unobservable endowments and attributes, i.e., the estimated coefficient representing (ρ_c-ρ_n) is not significantly different from zero at the 5 percent level. The restricted equation was estimated therefore to reflect these restrictions in the full switching model. This estimated output supply equation has an adjusted R^2 value of 0.70, implying that the estimated equation explains 70 percent of the variations in the value of output. The subsequent discussion uses the estimates of this restricted equation.

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[5] The computed value of -2(Log likelihood ratio) is -202.49 and this is greater than the one percent critical value of χ^2 (15 degrees of freedom).

Except for firm age, household size, trading (dummy), Iloilo (provincial dummy), and experience (dummy) variables, all the other variables in the output supply equation are statistically significant at the one to 10 percent level and have the expected signs (see Table 4). The positive coefficient of number of family labor implies that the more family members work in the enterprise, the more labor can be utilized to produce more output. Family labor is particularly important in the early stages of enterprise development when there are limited funds to enable the operator to hire additional labor. The marginal contribution of family labor during these times, therefore, is relatively high. The positive coefficient of the number of hired workers implies that as the enterprise increases in size in terms of number of workers, output will also increase. The positive coefficient of the value of total assets implies that the more assets the enterprise has, the more resources are available for its production. Moreover, if total assets consist of fixed assets like equipment, the stronger the positive effect on output.

Working capital also has a positive coefficient, implying that the more working capital available to finance current operations, the more inputs can be used to produce a higher level of output. Higher levels of working capital imply less financial constraints on the enterprise. Cost per hour of labor is also positively related to output. This implies that the hourly cost of labor is positively related with enterprise output. This is consistent with the results of many other studies [see Mellow (1982), Barron et al. (1987), Brown and Medoff (1989), Idson and Feaster (1990), and Kraybill et al. (1991), for example]. This finding can be explained by: (1) the "efficiency wage" hypothesis whereby firms pay a premium for highly disciplined workers, and relatively larger firms, i.e., those with larger output may be more accustomed to doing this than small firms; or by (2) economies of scale that allow relatively larger firms to pay their workers more. The average number of hours the enterprise operates can be considered a proxy for motivation and learning [Variyam and Kraybill (1994), Dunkelberg and Cooper (1990)]. The positive coefficient implies that the longer the enterprise operates, the greater the opportunity to learn, become more productive, and generate more output.

The loan variable also has a positive coefficient. As discussed above, borrowed funds can affect output by allowing the entrepreneur to use more optimal levels of inputs, newer technology, and more intense input use. Additional funds from loans help the entrepreneur overcome financial constraints on the purchase and allocation of optimal inputs, thereby allowing the entrepreneur to enhance allocative efficiency and increase output.

Among the provincial dummies, Cebu and Bohol have statistically significant coefficients. The positive coefficient of the Cebu dummy variable indicates that enterprises operating in Cebu have larger output relative to, say, Negros Occidental. This implies that the prevailing market conditions and opportunities in Cebu are more favorable to rural nonfarm enterprises relative to the other survey areas. On the other hand, the negative coefficient of Bohol suggests the opposite, i.e., that the output of rural nonfarm enterprises in Bohol are negatively affected by the environment in which they operate. This is consistent with Bohol being the least developed in terms of infrastructure and markets, despite its closeness to rapidly growing Cebu. Bohol has not taken advantage of the market opportunities presented by the economic boom in Cebu. One major fac-

tor could be the limited infrastructure in the province of Bohol that hinders easy access to other markets within and outside the province.

5.3. Estimates of the credit effect measures

Table 5 reports the estimates for the measures of credit effect. The random credit effect (equation 10a) is estimated to be 0.23 and is statistically significant at the 1 percent level. This implies an increase of 23 percent in output due to borrowing for an average entrepreneur who has obtained a loan. The anticipated output of a self-selecting borrower is also estimated to be 23 percent larger than if he or she were in the counterfactual state of being a nonborrower.[6]

Table 5 also shows that the marginal effect of credit is positive (equation 11). At the mean loan size, credit is estimated to have a marginal effect of 1.73, implying that the marginal output effect of one more peso of loan is ₱1.73. This estimate is statistically significant at the 1 percent level. This estimated effect also implies that at the observed mean loan size of ₱20 thousand, the marginal return to credit is larger than the average cost of credit which is about 35 percent. When evaluated at zero loan size, the marginal credit effect is estimated to be 1.79, implying a potential increase of more than a peso in output for every peso of loan. This estimate also indicates a 79 percent shadow price of credit, suggesting a potentially high return to loans to rural nonfarm entrepreneurs. The transaction costs involved in getting and repaying a loan may reduce the marginal credit effect by an unmeasured amount.[7]

6. Conclusions and policy implications

The descriptive statistical analysis of characteristics between borrowers and nonborrowers and rural nonfarm enterprises in the Visayas region showed that borrowers have a larger output and net income than nonborrowers. This observed differential performance in favor of borrowers can lead one to attribute the difference solely to the effect of credit use. But is this really the case among rural nonfarm enterprises?

This paper utilizes an econometric model that allows for the separation of the true credit effects from the effects of observable and unobservable attributes of borrowers and nonborrowers. Under such a framework, the different components that underlie the performance gap between borrowers and nonborrowers are identified. The results of the econometric estimates indicate that

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[6] The random credit effect and the counterfactual effect are equal under the restricted specification of the model.

[7] A study by Untalan and Cuevas (1988) estimated that loan processing and loan recovery costs account for about 30 and 41 percent, respectively, of total lending costs by banks operating outside of Metro Manila. The banks included in the study were commercial bank branches, private development banks, and rural banks.

an average entrepreneur/enterprise would expect a 23 percent increase in output when obtaining the observed average loan size. The econometric estimates do not support the hypothesis that latent attributes of borrowers and nonborrowers explain a large part of the observed difference in performance. Moreover, the hypothesis that credit only has direct productivity effects and does not enhance returns to latent or observable attributes cannot be rejected as well. The anticipated output of a self-selecting borrower is also estimated to be 23 percent larger than output in the counterfactual state of nonborrowing. These results suggest that the posited positive relationship between credit and output has a strong empirical basis and that the pure credit effect is not negligible. Hence, there appears to be potential for a positive impact of credit expansion for rural nonfarm enterprises in the Visayas region.

Estimates of the marginal effect of credit indicate a positive marginal impact of borrowing on output. The estimated marginal return to loans at the observed average loan size is larger than the average rate of interest charged in the rural credit market. This implies that rural nonfarm entrepreneurs are potentially capable of paying market rates of interest. Since transactions costs were not accounted for in the estimates, however, it cannot be precisely ascertained what the net return will be. Data on borrowing transaction costs were not obtained in the survey, so it was not possible to adjust the estimates to include these costs.

An estimate of the shadow price of capital also suggests that an entrepreneur selected at random will realize a marginal increase of ₱1.79 in output for a peso of loan, implying that rural nonfarm entrepreneurs are credit constrained. Thus, it appears that it is not just the nonborrowers who are credit constrained, but also borrowers as well. This suggests the prevalence of inefficient rural credit markets in the Visayas region which leaves many of these entrepreneurs credit rationed. While borrowers are able to partly solve their financial constraints by successfully obtaining loans from the credit market, they may still be credit rationed by receiving less than their loan demand, i.e., loan size rationed. This opens the issue of whether the informal credit market which is largely the main source of finance for these rural nonfarm entrepreneurs can efficiently and effectively meet the entrepreneurial credit demand, or whether the long-term optimal solution requires formal financial institutions to develop innovative ways of servicing the demand for finance by these entrepreneurs.

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APPENDIX

Table 1: Descriptive statistics of borrowers and nonborrowers

Mean values	Borrower n=217	Nonborrower n=183	t-value
Gross sales	856,161 (3,541,775)	313,791 (785,416)	-2.1928**
Net income	107,541 (194,159)	65,627 (106,433)	-2.7305*
Total assets	470,622 (990,799)	283,555 (762,978)	-2.1311**
Land (in peso value)	24,163 (77,399)	12,052 (30,303)	-2.0884**
Personal assets	291,611 (559,656)	168,203 (286,486)	-2.8372**
Number of workers at the start	4.7 (8.3)	3.2 (3.4)	-2.4578**
Number of workers currently	5.8 (8.8)	4.2 (7.5)	-1.930***
Number of hired workers at start	3.0 (8.3)	1.6 (3.3)	-2 24**
Number of hired workers currently	3.9 (8.8)	2.4 (6.8)	-1.93***
Hourly wage rate	7.16 (6.57)	4.55 (4.12)	-4.8091*
Number of months operated in 1991	11.8 (0.8)	11.4 (1.9)	-2.5968*
Number of hours operated in 1991	9.1 (2.25)	8.6 (2.0)	-2.3427**
Number of hours workers worked per day in 1991	8.9 (2.2)	8.5 (2.1)	-1.6629***
Income reinvested in the enterprise	48,843 (114,528)	24,774 (57,976)	-2.7064**
Income reinvested as working capital	58,138 (128,494)	29,080 (67,036)	-2.8914**

Note: * - significant at 1 percent
** - significant at 5 percent
*** - significant at 10 percent

Figures in parentheses are estimated standard deviation.

Table 2: List of variables in the empirical model

THE CREDIT STATUS EQUATION (PROBIT)

DEPENDENT VARIABLE: 1 IF A BORROWER, 0 OTHERWISE

INDEPENDENT VARIABLES.

- FIXED ASSETS
- TOTAL ASSETS
- FINANCIAL ASSETS
- AGE OF THE ENTERPRISE
- AGE OF THE ENTREPRENEUR
- HOUSEHOLD SIZE
- NO. OF YEARS IN SCHOOL
- PREVIOUS YEAR'S INCOME
- GENDER (DUMMY: 1 IF MALE, O IF FEMALE)
- BANK ACCOUNT (DUMMY: 1 IF WITH BANK ACCOUNT, 0 OTHERWISE)
- BOHOL (DUMMY: 1 IF LOCATED IN BOHOL, 0 OTHERWISE)
- ILOILO (DUMMY: 1 IF LOCATED IN ILOILO, 0 OTHERWISE)
- CEBU (DUMMY: 1 IF LOCATED IN CEBU, 0 OTHERWISE)
- MFG (DUMMY: 1 IF MANUFACTURING, 0 OTHERWISE)
- TRADING (DUMMY: 1 IF TRADING, 0 OTHERWISE)

OUTPUT SUPPLY EQUATION:

DEPENDENT VARIABLE: VALUE OUTPUT

INDEPENDENT VARIABLES:

- NO. OF FAMILY WORKERS
- NO. OF HIRED WORKERS
- TOTAL ASSETS
- WORKING CAPITAL
- COST PER HOUR OF LABOR
- AGE OF THE ENTERPRISE
- HOUSEHOLD SIZE
- AVE. NO. OF HOURS OPERATED
- LOAN AMOUNT
- LOAN AMOUNT SQUARED
- EXPERIENCE (DUMMY: 1 IF WITH EXPERIENCE, 0 OTHERWISE)
- PROVINCE AND ACTIVITY DUMMIES (SAME AS IN PROBIT EQUATION)
- PDF (Probability density function or $\phi(C)$ in the model)
- INTERACTION TERMS OF VARIABLES AND CDF (Cumulative density function or $\Phi(C)$ in the model)

Table 3: Estimated coefficients of the probit equation

Variable	Coefficient	Chi-square value
Constant	-0.3027789	1.803943
Fixed assets	0.25785266	1.555336
Total assets	-0.9171156	7.551057*
Financial assets	0.26871197	5.047989**
Age of the enterprise	0.00271617	0.001063
Age of the entrepreneur	0.09070919	1.078551
Household size	-0.1012642	1.814128
No. of years in school	0.16475565	3.191481***
Previous year's income	-0.0798151	0.853162
Gender (dummy)	0.3449918	4.931064**
Bank account (dummy)	0.14875312	0.808113
Bohol (dummy)	0.21549624	0.738952
Iloilo (dummy)	0.57348225	6.878012*
Cebu (dummy)	0.1392916	0.411719
Manufacturing (dummy)	-0.3086151	2.315414
Trading (dummy)	-0.8865755	22.89473*
Log likelihood ratio Percent correctly predicted	-202.4874475 84.00	

Note: * Significant at 1 percent.
** Significant at 5 percent.
*** Significant at 10 percent.

Table 4: Estimated coefficients of the endogenous switching regression model

Variable	OLS	Endogenous Switching Regression		
		Full Switching Model		Restricted Model
		All	Borrower Differential	
Constant	4.738543 (8.041)*	-1.295507 (-0.510)	9.251535 (2.364)**	4.360621 (6.829)*
No. of family workers	0.242519 (2.876)*	-0.017823 (-0.073)	0.666508 (1.352)	0.273229 (2.800)**
No. of hired workers	0.231969 (3.494)*	-0.180227 (-1.018)	0.885918 (2.303)**	0.167336 (2.269)**
Total assets	0.093367 (2.636)*	0.290907 (2.560)*	-0.281013 (-1.340)	0.145180 (3.675)*
Working capital	0.408793 (13.89)*	0.526370 (6.073)*	-0.312765 (-1.692)***	0.394831 (12.298)*
Cost per hour of labor (peso/hr)	0.116205 (2.189)**	0.412604 (2.574)*	-0.681619 (-2.002)**	0.137971 (2.391)**
Age of enterprise	0.085102 (1.877)***	0.176075 (1.311)	-0.248552 (-0.902)	0.074787 (1.369)
Household size	-0.028935 (-0.346)	-0.044101 (-0.188)	0.208046 (0.427)	-0.012624 (-0.137)
Ave. no. of hours operated	0.386424 (2.072)**	0.884029 (1.531)	-1.002134 (-0.891)	0.344517 (1.713)***
Mfg. (dummy)	-0.277187 (-2.402)**	0.258388 (0.437)	-0.882149 (-0.852)	-0.255514 (-2.037)**
Trdg. (dummy)	-0.053948 (-0.476)	0.334885 (0.512)	-0.315130 (-0.216)	-0.023815 (-0.191)
Bohol (dummy)	-0.637754 (-4.154)*	-0.763465 (-1.888)***	0.270541 (0.285)	-0.596292 (-3.631)*
Iloilo (dummy)	-0.134032 (-1.093)	-0.312807 (-0.656)	0.148047 (0.141)	-0.109236 (-0.816)
Cebu (dummy)	0.469132 (4.245)*	0.594503 (1.884)***	-0.476475 (-0.607)	0.468399 (3.669)*
Experience (dummy)	0.160606 (1.831)***	0.112733 (0.475)	0.128780 (0.257)	0.147340 (1.513)
Loans	0.000011640 (3.212)*		0.00001087 (2.213)**	0.000011758 (2.448)**
$Loans^2$	$-3.88123x10^{-12}$ (-1.907)***		$-1.04995x10^{-11}$ (-1.263)	$-1.11392x10^{-11}$ (-1.366)
Pdf			2.685880 (1.358)	
Adj. R^2	0.72		0.70	0.70

Note: Figures in parentheses are t-values.
* Significant at 1 percent.
** Significant at 5 percent.
*** Significant at 10 percent.

Table 5: Estimated values of credit effects

Credit Effect	Estimated value
Gross output supply gap (at mean loan size)	0.23053 (0.000003)*
Random credit effect (at mean loan size)	0.23079 (0.000004)*
Marginal credit effect (at mean loan size)	1.7329 (0.3242)*
Marginal credit effect (at zero loan size)	1.7940 (0.3357)*

Note: Figures in parentheses are standard errors. Under the restricted switching regression specification, random credit effect is equal to the counterfactual effect.

* Significant at 1 percent.

Source of Data: Table 4.

Sampling Design for the Study of Rural Nonfarm Enterprises

The sampling design for the study of rural nonfarm enterprises is two-stage random sampling within the primary sampling units (PSUs). The sampling frame used was the list of establishments that the National Statistics Office uses in the Annual Survey of Establishments. This list includes establishments with a fixed location. Hence, itinerant vendors and enterprises with no fixed place of operation are not included in the sampling frame.

The rural areas of the provinces of Iloilo, Negros Occidental, Cebu, and Bohol are the principal domains of the survey. These include all areas except the cities of Iloilo, Bacolod, Bago, Cadiz, La Carlota, San Carlos, Silay, Cebu, Danao, Lapu-lapu, Mandaue, Toledo, and Tagbilaran.

The municipalities are the PSUs while the barangays are the secondary sampling units (SSUs). Within each domain, a predetermined number of PSUs are chosen (i. e., two PSUs each for Iloilo and Negros Occidental and three PSUs each for Cebu and Bohol). These PSUs are selected as follows:

- Within each province, list all the municipalities and rank them according to the number of nonfarm establishments in each municipality from biggest to smallest. Exclude from the list those municipalities that have peace and order problems (based on report obtained from the regional offices of the National Economic and Development Authority during the ocular inspection of the survey area), as well as municipalities that have enterprises engaged in only one or two types of nonfarm activities.

- Select the PSUs from each province randomly with probability proportional to the number of establishments.

Within each PSU, barangays are chosen randomly with probability proportional to the number of enterprises in each barangay. For the first barangay to be randomly picked, the number of establishments in that barangay are evaluated. If the number of establishments in, say, barangay 1 is less than the total number of targeted sample establishments for the municipality, then all of these establishments are included in the sample establishments for the municipality. Then another barangay is randomly picked from among the barangays in that particular municipality and the same process is continued until such time that the required number of establishments for the municipality is met. If the number of establishments for the last barangay to be randomly picked is greater than the required sample, then the sample establishments from that barangay are selected using systematic random sampling.

Taking into account cost considerations, the decision reached is for a sample of 400 enterprises distributed as follows:

Iloilo	100
Negros Occidental	100
Cebu	150
Bohol	50

This sample size is fairly substantial to provide adequate statistics for the various statistical analyses to be undertaken.